

QUALITY ASSURANCE FOR AVIATION INFORMATION DISPLAY

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Concern for public safety requires some kind of quality assurance to guarantee the usability of aviation information interfaces.

Q: How can we (the aviation community) accomplish that?

A: See that human factors engineering is properly integrated into the design, development and testing of the product that gets deployed, i.e., see that...

- Management allocates sufficient resources (money, schedule) for human factors work in the initial design and subsequent testing and modification cycles.
- The design team includes
 - User/Subject Matter Experts
 - Human Factors Experts (training, experience)
 - Software Engineering Experts*with equal authority over the design.*
- The design team retains sufficient design authority throughout short cycles of testing and modification until deployment.
- Management protects the design process from the usual pressures (money, schedule, political and commercial interests).

Meanwhile, back in the real world...

- Depending on the application, product development is in hands of either manufacturers or government contractors.
- FAA has oversight, regulatory authority.
- Trained and experienced human factors experts rarely have sufficient design authority. Usual role (if any) is in testing or review of nearly complete product when only cosmetic changes possible. (Alan Cooper, 1999)
- Designers, managers of design are usually former sw, hw engineers or subject matter experts.

As we are continuing to advocate the proper process, what can we do in the meantime?

We can try to improve the HF performance of the non-HF-expert designers.

We can try to convince developers that

- Usability issues can sink their project.
- There is systematic HF knowledge that can be applied.
- They need to get and use professional HF help.

Traditional resources for quality assurance:

- Procedural prescriptions (design checklists).
- Numerous guidelines and standards: FAA, RTCA, SAE, DoD, DoE, ANSI, ISO, ...

For simple displays, guidelines and standards about individual graphic elements *might* be sufficient to ensure at least minimally usable legibility and attention-management.

“The minimum level of luminance recommended for characters on a VDT, regardless of wavelength, shall be 70 cd/m² (20 fl) with a level of 170 cd/m² (50 fl) preferred.”

NASA-STD-3000, 9.4.2.3.3.9 Visual Display Terminal Design Requirements

“An adequate contrast of at least 7:1 should be maintained between foreground and background colors to enhance color perception and perceived image resolution.” [Source: CTA, 1996]

FAA HFDS, p 8-61.

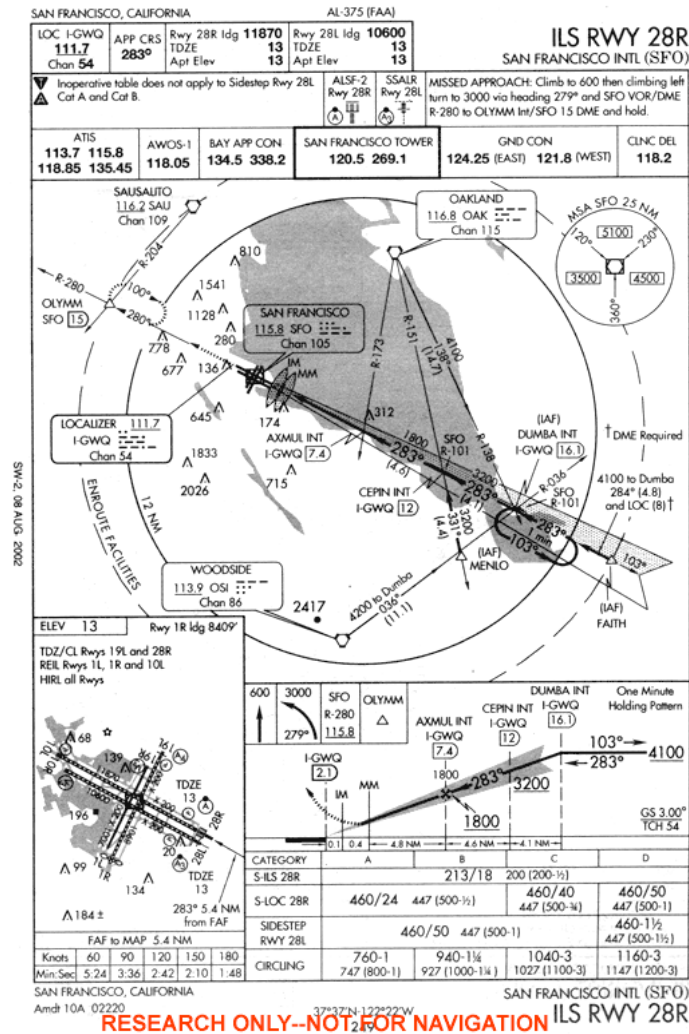
Until recently displays have looked like this:



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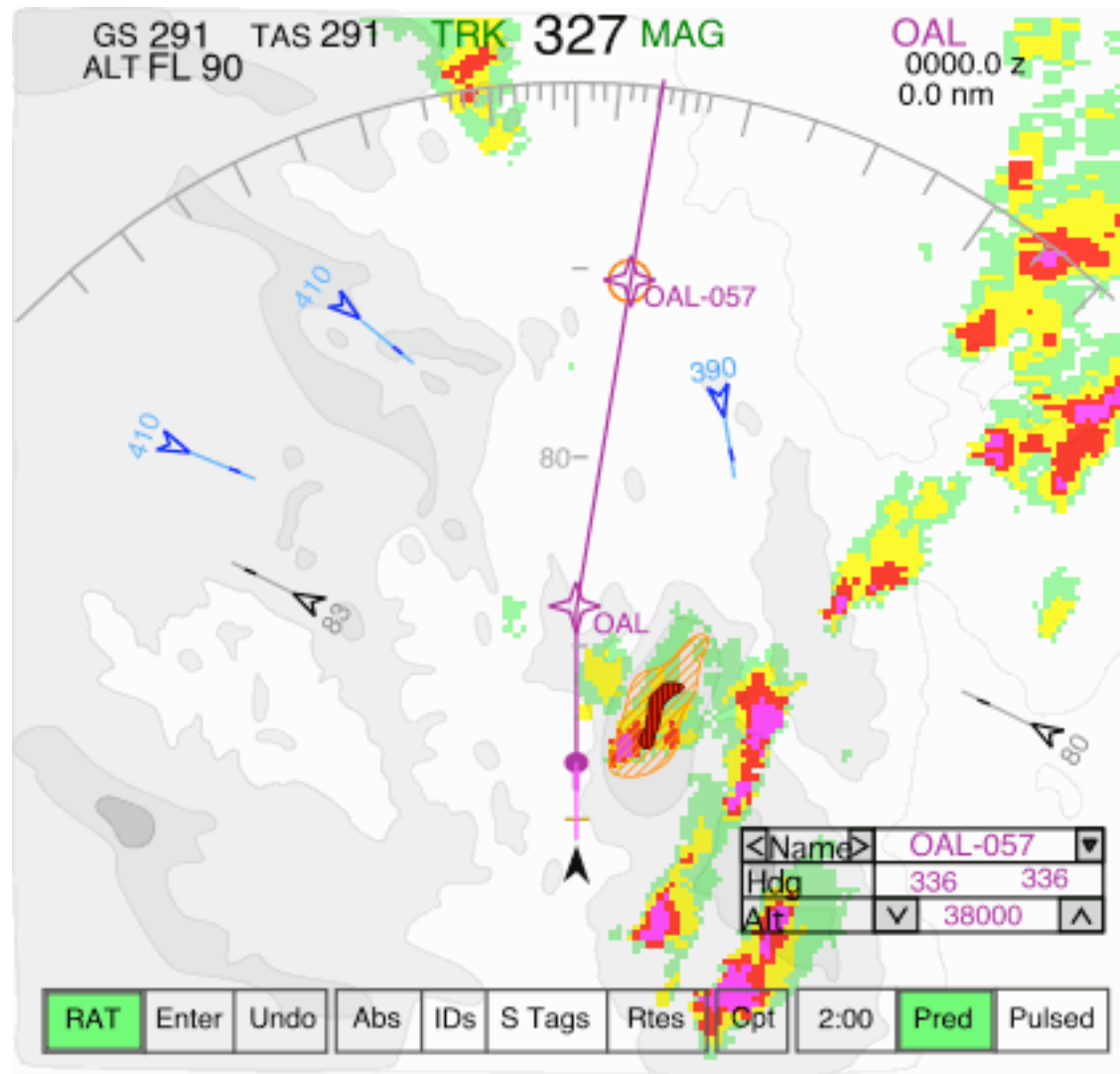
Or this:



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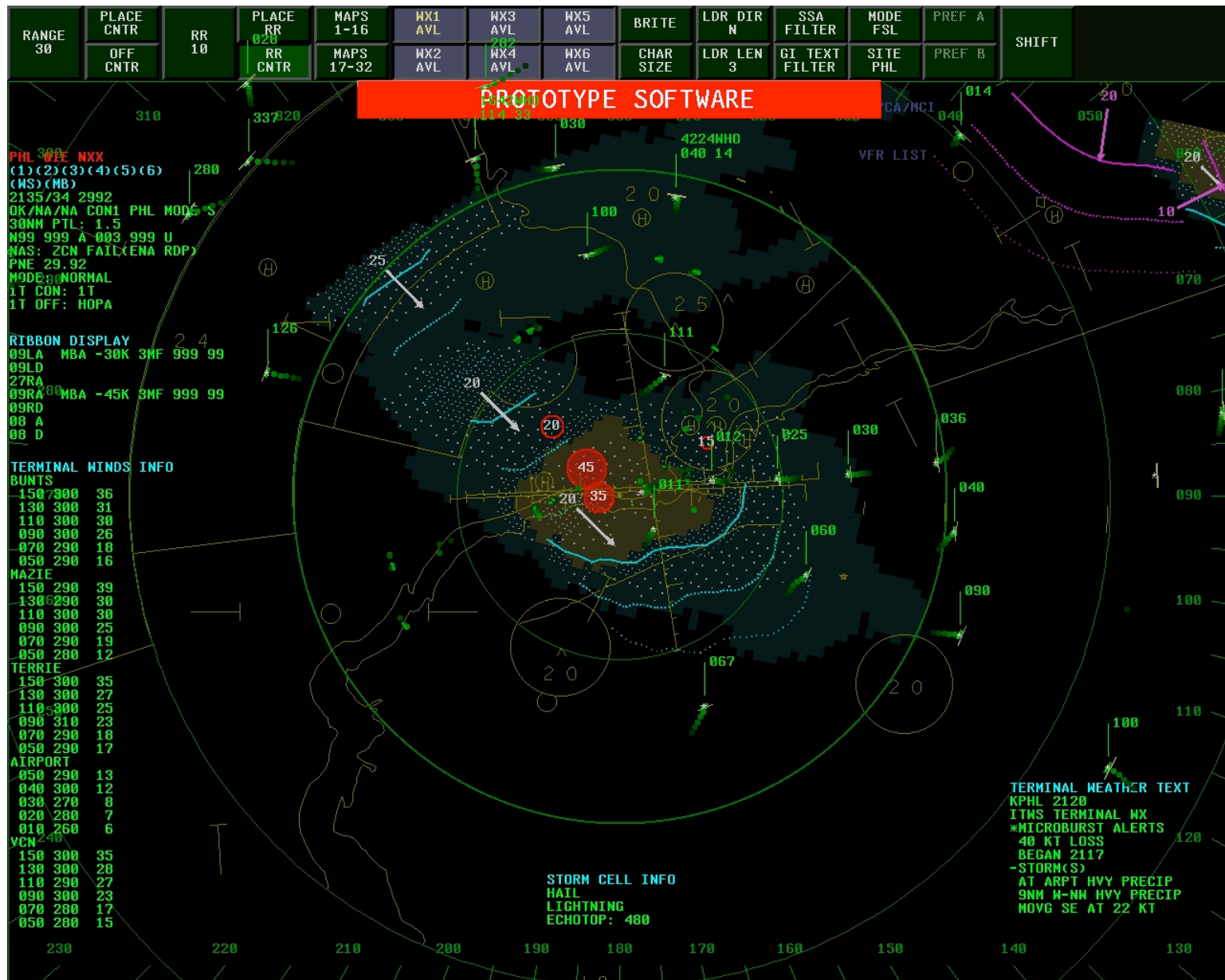
New displays are looking more like this:



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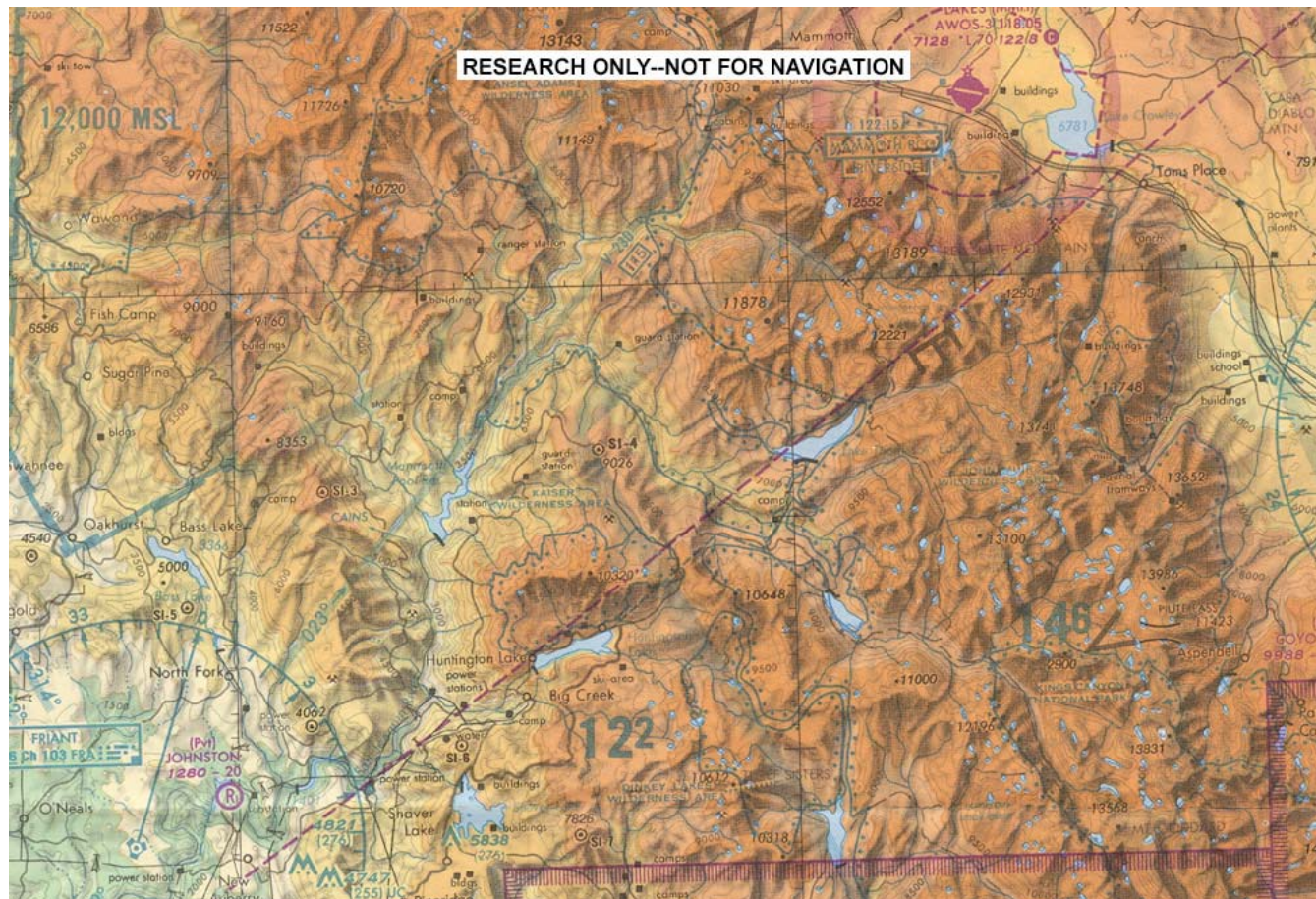
Or:



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Or this:



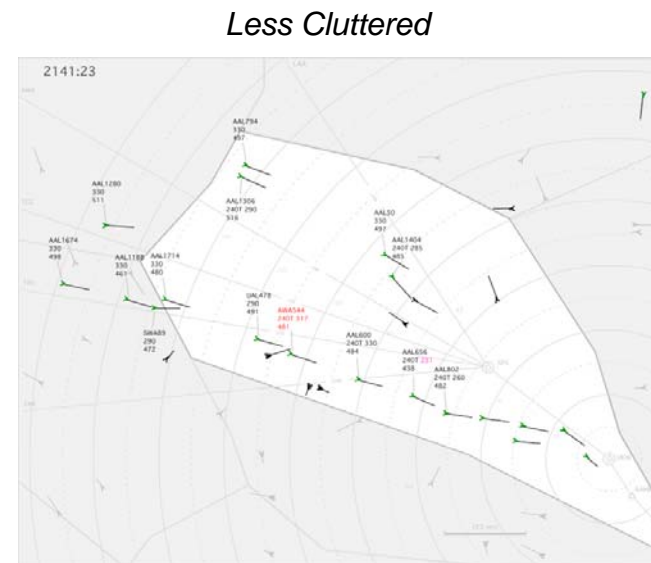
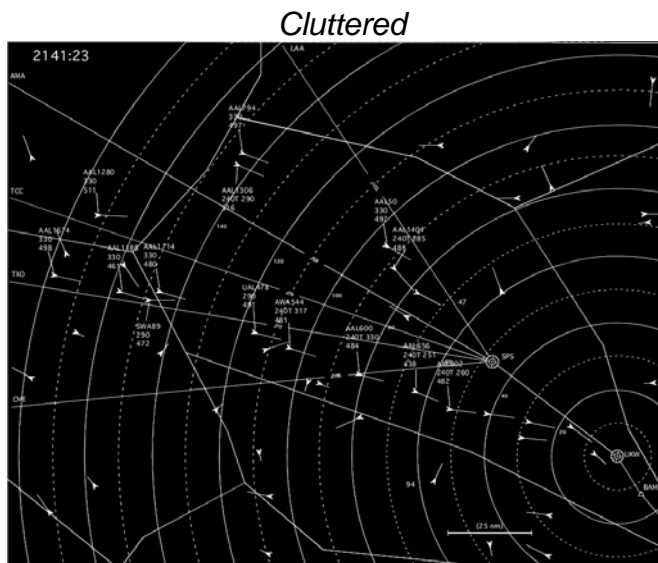
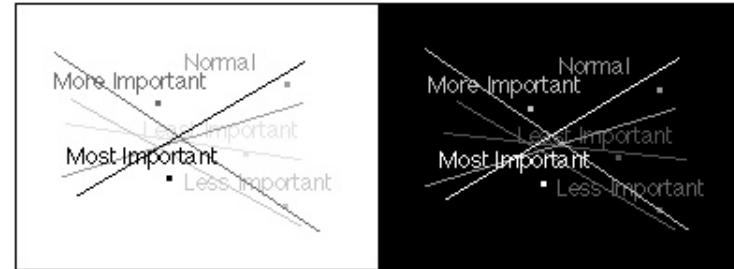
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For more complex displays, standards about individual graphic elements are too rigid.

Example:

Letting non-critical information be presented at low contrast allows more context without visual clutter.



Performance-based standards give designers the flexibility needed for usable high-density designs:

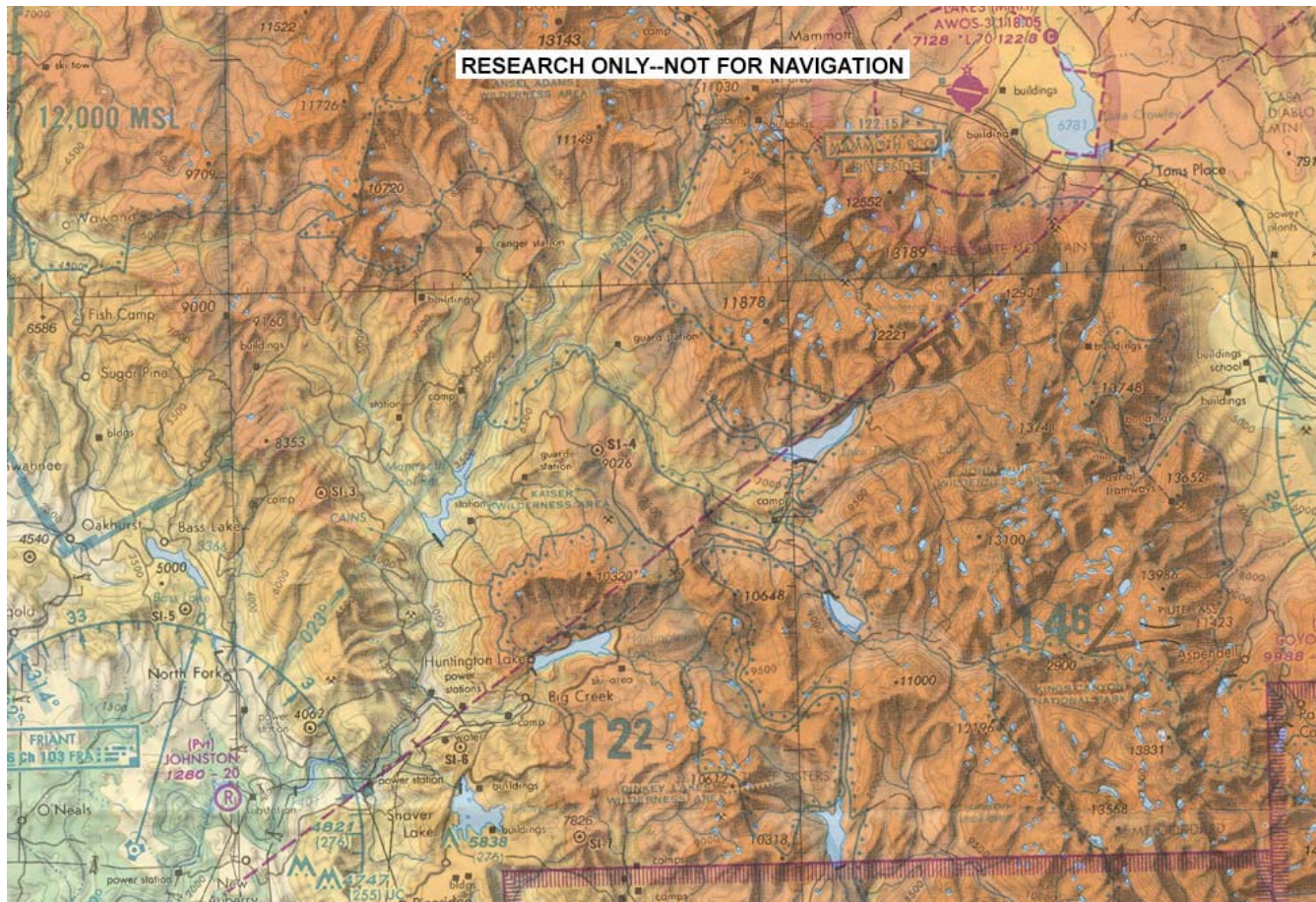
The contrast between text and its background shall be sufficiently high to ensure readability of the text. [Source: DOD HCISG V2.0, 1992]

FAA HFDS, p 8-61.

“...In all cases the luminance contrast and/or color differences between all symbols, characters, lines, or all backgrounds shall be sufficient to preclude confusion or ambiguity as to information content of any displayed information.”

Society of Automotive Engineers, AS8034 *Minimum Performance Standards for Airborne Multipurpose Electronic Displays*, SAE, Warrendale, Pennsylvania: 1993, p. 7.

Even if performance standards are well-written, how are hw, sw engineers to understand and meet them?



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We're investigating how web technologies might support more effective tools.

<http://colorusage.arc.nasa.gov>

Color design chosen as test case.

<http://colorusage.arc.nasa.gov>

The html format allows a wide variety of material to be cross referenced:

- Standards, with color examples of good and bad usage.
- Design checklist covering issues to be considered
- Design tools to support systematic design
- Reference material outlining color science behind standards
- Pointers to other sources--literature, sites, courses, orgs.

- The website is currently in initial form, a research product.
- At this point is free advice, persuasion:
 - No fancy stuff, all business
 - Not for color experts
 - Only what can be demonstrated
- A regulatory, FAA site would have additional possibilities, e.g.:
 - Could support common expectations between FAA and developer
 - Could include mandatory design checklist

Google Keywords:

crt luminance brightness contrast
types of cockpit displays
attention management
NATS Standard air traffic control displays
cockpit display design
navigation display and weather and terrain
levels of urgency
cockpit graphics
mil-hdbk-87213
international color usage
aviation maps
luminance contrast
specifying Munsell color
noaa aviation charts
faa symbol logo
nits lght
color discrimination

color vision anomalies
selecting several visually distinct colros
xyy color graph
blue contrast colors
aviation map symbology
aviation 3d charts
aviation maps
color changing tool
color display guidelines
color legibility
contrast color
...

Supporting the FAA's certification staff:

DOT/FAA/AM-01/17, Human Factors Design Guidelines for Multifunction Displays. Mejdal, S., McCauley, M.E., Beringer, D.B. 2001

DOT/FAA/OAM-TM-03-01 Multi-Function Displays: A Guide for Human Factors Evaluation. Chamberlain, R. M., Heers, S. T., Mejdal, S., Delnegro, R. A., & Beringer, D. B., 2003